Biological and Water Quality Study of the

Grand River

- Lake, Ashtabula & Geauga Counties, Ohio.

1987

prepared by

Ohio Environmental Protection Agency
Division of Water Quality Monitoring and Assessment
Surface Water Section
1030 King Ave
Columbus, Ohio 43212

ACKNOWLEDGMENTS

The following Ohio EPA staff are acknowledged for their significant contribution to this report

Ambient Chemical Quality - Dave Stroud: Lower Grand River, Ken Frase: Upper Grand River

Biological Assessment:

Macroinvertebrates -Mike Bolton

Fish -Roger Thoma

Editing - Marc Smith

Typing - Lisa Palsgrove, Pam Jaques, Marc Smith

This evaluation and report would not have been possible without the assistance of numerous full and part time staff in the field and the chemistry analyses provided by the Ohio EPA Water Quality Laboratory

Biological and Water Quality Survey of the Grand River (Lake, Ashtabula & Geauga County)

Ohio EPA, Division of Water Quality Monitoring & Assessment
Surface Water Section
1030 King Ave
Columbus, Ohio 43212

Introduction

The Grand River study area extended from Brandt Rd. (RM 28.4) downstream to the mouth (Figure 1, Table 1).

Specific objectives of this evaluation were to:

1) biologically evaluate the existing Warmwater Habitat use designation.

2) evaluate the impact on water quality resulting discharges from the Painesville WWTP, leachate and runoff from the Diamond Shamrock soda ash and chromate disposal landfills, and the Chardon WWTP on Big Creek. Several other municipal and industrial dischargers were also evaluated as a result of their presence in the study area.

The findings of this evaluation may factor into regulatory actions taken by Ohio EPA (e.g. NPDES permits) and eventually be incorporated into the State water quality management plans and biennial 305(b) report.

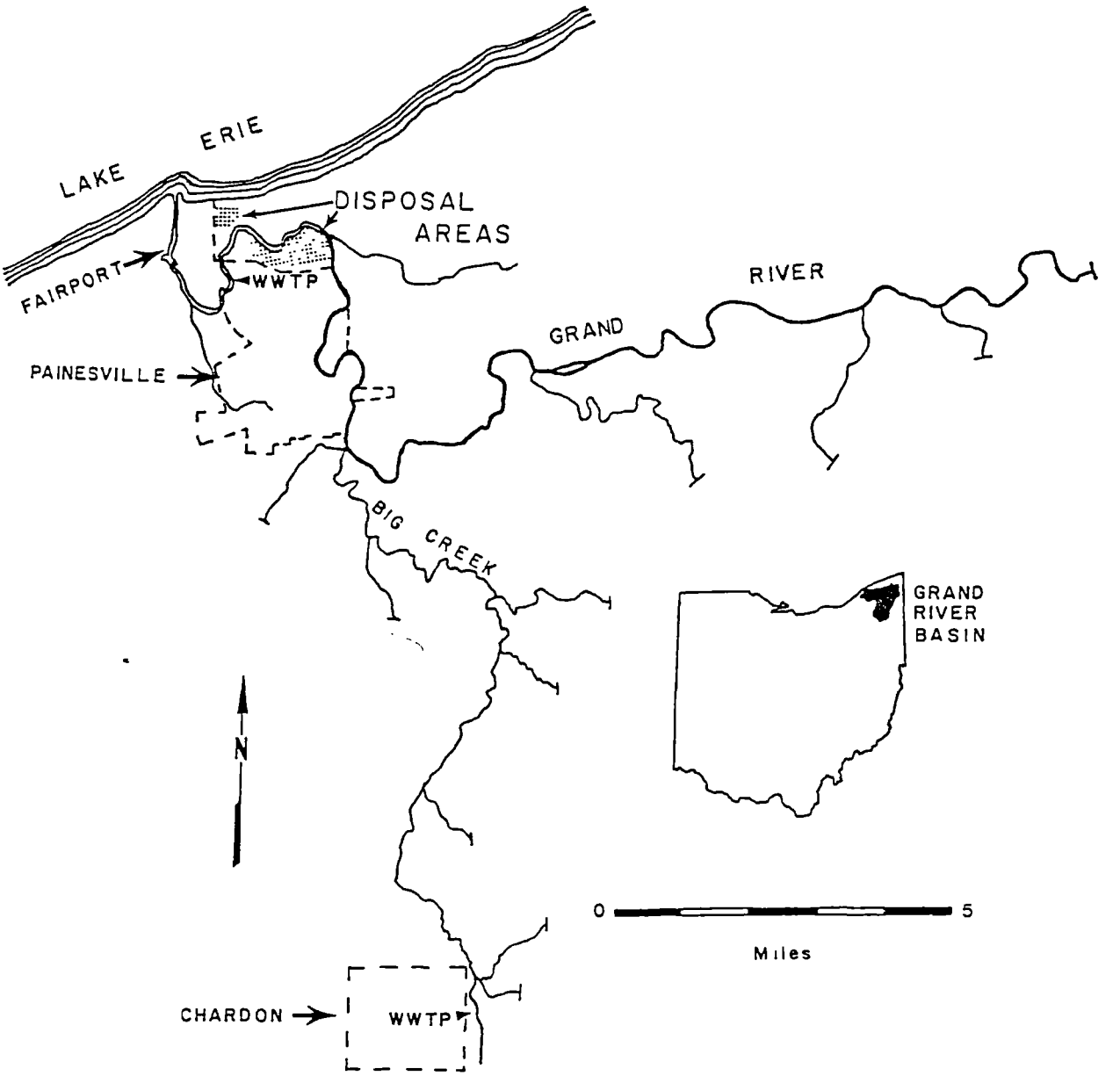

Figure 1 The Grand River study area showing principal streams and tributaries, population centers, and pollution sources

Table 1. Sampling locations (effluent sample - E, water chemistry - C sediment chemistry - S, benthos - B, fish - F, fish tissue - FT) in the Grand River study area, 1987

Stream/ River Mile	Type of Sampling	County	Township	Latitude/Longitude	Landmark	USGS 7 5 min Quad. Map
28.4	B	Ashtabula	Harpersfield	41 45'26"/80 58'19"	Brandt Rd.	Geneva
22.6	B	Lake	Madison	41 44'27"/81 02'49"	Ust. SR 528	Thompson
22.5	C	Lake	Madison	41 44'26"/81 02'48"	Dst. SR 528	Thompson
22.1	F	Lake	Madison	41 44'31"/81 03'10"	Dst Sr 528	Thompson
13 6	B	Lake	Perry	41 43'32"/81 11'09"	Dst. Vrooman Rd.	Thompson
13.4	F	Lake	Painesville	41 43'47"/81 11'06"	Dst Vrooman Rd	Thompson
9 0	F,FT	Lake	Painesville	41 42'40"/81 13'45"	Dst Big Cr	Painesville
8 6	B	Lake	Painesville	41 43'43"/81 13'45"	Ust. SR 84	Painesville
8 5	C	Lake	Painesville	41 43'09"/81 13'41"	SR 84 Bridge	Painesville
6 2	B	Lake	Painesville	41 44'03"/81 14'09"	Adj Rec. Park	Painesville
6 1	F,C	Lake	Painesville	41 44'10"/81 14'10"	Ust. Gibb's Outfall	Painesville
5 5	C	Lake	Painesville	41 44'46"/81 13'54"	At SR 2 Bridge	Painesville
5 4	B	Lake	Painesville	41 44'28"/81 13'56"	Dst SR 2	Painesville
5.2	F	Lake	Painesville	41 44'47"/81 14'07"	Dst. Gibb's Outfall	Painesville
4.4	F,FT	Lake	Painesville	41 45'28"/81 14'24"	Dst. Salt Landfill	Perry
4 3	B	Lake	Painesville	41 45'13"/81 14'39"	Adj Salt Landfill	Mentor
3 1	C	Lake	Painesville	41 44'44"/81 15'47"	Ust. Landfills	Mentor
3 0	F,B	Lake	Painesville	41 44'41"/81 15'46"	Ust Paines WWTP	Mentor
2 8	C	Lake	Painesville	41 44'23"/81 15'45"	St. Clair St	Mentor
2 3	C/Surface	Lake	Painesville	41 44'09"/81 15'59"	SR 535	Mentor
2 3	C/Bottom	Lake	Painesville	41 44'09"/81 15'59"	SR 535	Mentor
2.1	B	Lake	Painesville	41 44'04"/81 16'13"	Ust Ram Island	Mentor
2 0	F,FT	Lake	Painesville	41 44'05"/81 16'13"	Dst. Paines WWTP	Mentor
1.8	C/Surface	Lake	Painesville	41 44'18"/81 16'34"	Dst. RR Bridge	Mentor
1.8	C/Bottom	Lake	Painesville	41 44'18"/81 16'34"	Dst. RR Bridge	Mentor
0 8	B	Lake	Painesville	41 44'57"/81 16'56"	Near mouth	Mentor

(cont)

Table 1. (cont.)

Stream/ River Mile	Type of Sampling	County	Township	Latitude/Longitude	Landmark	USGS 7.5 min Quad Map
0.6	F,FT	Lake	Painesville	41 45'06"/81 16'56"	Ust. Salt tipple	Mentor
0.3	C/Surface	Lake	Painesville	41 45'24"/81 16'52"	Near mouth	Mentor
0.3	C/Surface	Lake	Painesville	41 45'24"/81 16'52"	Near mouth	Mentor
Big Creek						
16.6	C	Geauga	Hambden	41 35'20"/81 11'25"	SR 6 Bridge	Chardon
16.3	F	Geauga	Hambden	41 35'05"/81 11'25"	Ust Char WWTP	Chardon
16.1	B	Geauga	Chardon	41 35'20"/81 11'30"	Ust. Char WWTP	Chardon
15.9	F	Geauga	Chardon	41 35'24"/81 11'30"	Dst. Char. WWTP	Chardon
15.8	B	Geauga	Hambden	41 35'28"/81 11'26"	Dst. Char WWTP	Chardon
14.6	C	Geauga	Chardon	41 36'21"/81 11'59"	Ust Woodin Rd.	Chardon
14.2	B	Geauga	Chardon	41 36'19"/81 11'59"	Ust. Woodin Rd	Chardon
13.9	F	Geauga	Chardon	41 36'26"/81 12'02"	Dst Woodin Rd	Chardon
9.5	F	Geauga	Concord	41 38'52"/81 11'18"	Ust SR 608	Chardon

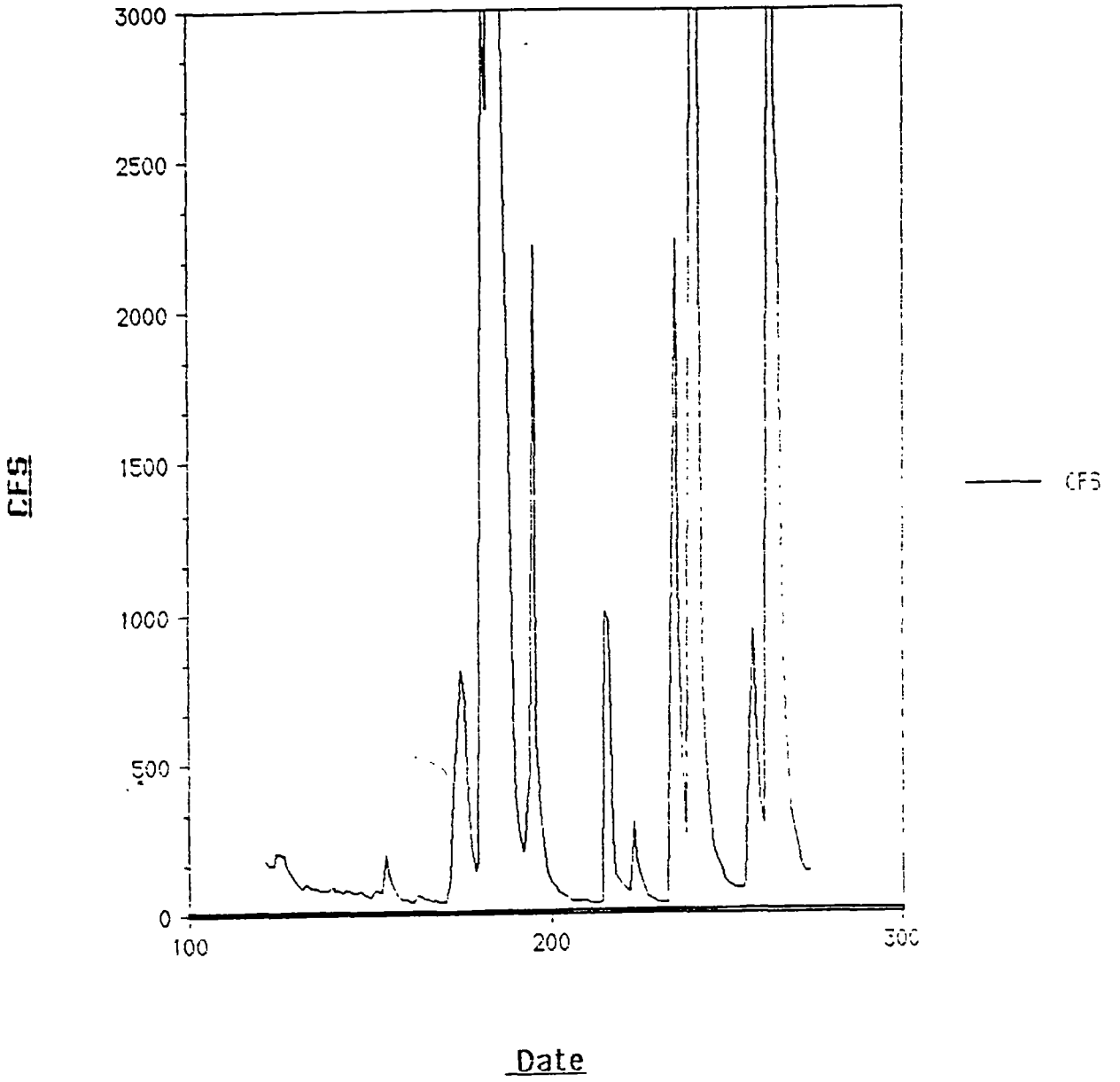

Figure 2. Flow hydrograph for the Grand River near Painesville, Ohio (RM 8.5); May through November, 1987 Sampling dates are indicated with low flow conditions shaded ($Q_{7,10}$ [0.9cfs] to 80% duration flow [12.0 cfs], May through November for the period of record 1974 to 1987). Dashed line indicates a change in scale

Results and Discussion

Biological and chemical impacts were apparent in the 1987 sampling results from Big Creek and the Grand River. Biological impacts resulting from changes in the quality of habitat were also detected. Highlights from the1987 field sampling results include :

Chemical, effluent and bioassay sampling (Tables 2-4)

Grand River

- Few chemical parameters exceeded water quality criteria. Violations of the TDS water quality criteria were found from RM 3.1 downstream to RM1.75. A single violation of the copper WQS was found in a surface grab at RM 1.1. Big Creek had violations of the D.O. WQS upstream from the Chardon WWTP and the IJC total phosphorus guideline downstream from the WWTP. Elevated iron concentrations were responsible for the majority of the exceedances of chemical water quality criteria in the Grand River study area with violations extending from RM 22.4 to the mouth.

- Water quality changed significantly downstream from the Diamond Shamrock Co waste lagoons. Concentrations of TDS, calcium, sodium, and chlorides increased downstream from the lagoons. Elevated concentrations of these chemicals persisted almost to the mouth where dilution with Lake Erie water resulted in lowered concentrations for these chemicals.

- Screening bioassays of Grand River water (upstream from the Painesville WWTP) and grab and composite samples of the pre-chlorination final effluent from the Painesville WWTP revealed no acute toxicity attributable to the Painesville WWTP or sources upstream from the plant. The issue of chronic toxicity from these sources was not addressed by further bioassay tests.

- The Painesville WWTP had no discernable impact on chemical water quality. Values for nutrients, solids and metals were similar upstream and downstream from the Painesville WWTP.

Table 3. Violations of Ohio EPA Warmwater/Exceptional Warmwater/Cold Water Habitat water quality standards (OAC 3745-1) chemical/physical parameters measured in the Grand River study area, 1987 (Concentrations given as ug/l unless otherwise noted).

Stream Name	River Mile	Violation: Parameter(value)
Grand River	22.4	Fe-TR (2080[a], 1340[a])
Grand River	8 5	Fe-TR (2420[a], 1620[a])
Grand River	6.1	Fe-TR (1610[a])
Grand River	5.5	Fe-TR (3310[a], 1700[a])
Grand River	3 1	Fe-TR (1030[a]); TDS (1670[a] 2730[a])
Grand River	2.8	Fe-TR (1650[a]), TDS 1670[a],2940[a])
Grand River	2 3 Bottom	Fe-TR (1890[a], 1070[a]); TDS (2060[a],2430[a]
Grand River	2 3 Surface	Fe-TR (1820[a]), 1960[a],2550[a])
Grand River	1 8 Bottom	Fe-TR (1120[a], 1710[a], 1250[a]); TDS (1640[a])
Grand River	1 8 Surface	Fe-TR (1270[a]); TDS (1690[a])
Grand River	1.1 Bottom	Fe-TR (3710[a], 2120[a], 1190[a], 1790[a])
Grand River	1 1 Surface	Fe-TR (1250[a], 1000[a]); Cu-TR (18 5[a])
Grand River	0.3 Bottom	Fe-TR (1950[a], 2370[a])
Grand River	0.3 Surface	Fe-TR (1120[a])
Big Creek	16 6	D.O. (3 2 mg/l[a], 3 5 mg/l[a], 3 95 mg/l[a]), Fe-TR (2110[a] 1870[a], 2060[a])
Big Creek	14 6	Fe-TR (1560[a]), Phosphorus-T (2 2 mg/l[c], 2 74 mg/l[c], 1 98 mg/l[c])

a indicates violation of numerical WQS for prevention of chronic toxicity

b indicates violation of numerical WQS for prevention of acute toxicity

c indicates a violation of the IJC guideline of 1.0 mg/l for tributaries to the Great Lakes.

Table 4. Results (mean/maximum-minimum)[a] of chemical/physical sampling in the Grand River, Big Creek study area July-September, 1987.

CONVENTIONALS

STREAM RM	TEMP (C^0)	CNDUCTVY (mg/l)	DO (mg/l)	BOD-5DAY (mg/l)	COD (mg/l)	pH (SU)	RESIDUE TOT NFLT (mg/l)
Grand River							
22.5	19.3/24.0-13.0	237.5/261-183	8.1/10.3-6.9	-	35/35	8.0/8.2-7.7	24/62-5
8.5	18.0/23.0-13.5	267.0/313-187	8.1/10.0-6.5	-	37/42-32	7.8/8.0-7.4	26/37-13
6.1	20.0/24.0-14.0	296.0/324-270	8.5/10.6-6.9	-	26.5/32-21	8.0/8.1-8.0	17/26-8
5.5	20.0/24.0-14.0	278.0/335-194	8.3/10.0-6.3	-	29.6/33-26	8.0/8.1-7.8	9.3/10-8
3.1	24.0/30.0-17.0	1727/3300-825	8.1/8.9-7.3	1.45/1.5-1.4	33.0/46-26	7.9/8.2-7.6	11/15-7
Painesville WWTP							
2.8	24.0/29.5-17.5	1617/3500-880	8.0/8.6-7.1	1.65/1.8-1.5	35.0/51-25	7.9/8.2-7.4	11/21-6
2.3S	24.5/29.0-18.0	1765/3100-880	8.0/8.7-7.4	1.75/1.9-1.6	34.0/41-25	8.0/8.3-7.6	12/21-6
2.3B	24.5/29.0-18.0	1767/3000-880	8.0/8.7-7.5	1.4/1.4-1.4	33.0/44-29	8.0/8.2-7.6	15/23-11
1.8S	24.8/29.5-18.0	1322/1825-880	8.2/9.6-6.5	2.6/3.4-1.8	27.0/30-25	8.0/8.4-7.7	12/15-10
1.8B	24.0/29.0-17.5	1415/2100-855	7.2/8.4-6.3	1.8/2.0-1.5	30.0/33-29	7.8/8.1-7.5	24/29-16
1.1S	25.0/28.5-20.0	877/1300-340	7.2/9.0-5.6	1.9/2.0-1.7	22.5/26-20	7.9/8.3-7.4	10.5/14-5
1.1B	24.0/26.0-17.5	962/1100-825	6.3/6.2-5.4	1.3/1.3-1.2	24.5/28-20	7.7/7.9-7.6	24/28-19
0.3S	24.5/27.0-20.0	438/780-275	7.6/9.1-6.1	1.1/1.2-1.0	25.0/40-20	8.1/8.5-7.5	7/11-4
0.3B	23.5/27.0-19.0	647/1115-280	6.0/7.7-4.3	1.0/1.0-1.0	22.5/30-20	7.8/8.1-7.6	23/37-11
Big Creek							
16.6	16.4/20.0-9.0	387/432-319	3.5/4.0-3.2	2.5/2.9-2.3	36.8/41-34	7.8/8.1-7.6	13.7/26-7
Chardon WWTP							
14.0	16.3/20.0-10.0	610/756-466	5.7/7.8-4.2	3.0/4.5-1.3	24.2/28-21	7.6/7.6-7.4	6.7/9-5

(cont.)

Table 4 (continued)

NUTRIENTS

STREAM RM	NH3-N TOT (mg/l)	NO2-N TOT (mg/l)	TOT KJEL (mg/l)	NO2 & NO3 N TOT (mg/l)	PHOS TOT (mg/l)
22.6	0.05/0.05	0.02/0 02	0 625/0 8-0.4	0 435/0 5-0 37	0.065/0.1-0.05
8.5	0.05/0 05	0 02/0 02	0 475/0.8-0.3	0 33/0 58-0 1	0 075/0 1-0 05
6.1	0.05/0 05	0.02/0 02	0 466/0.6-0 3	0.28/0 28	0 07/0.09-0 05
5 5	0 05/0.05	0 02/0 02	0 475/0.8-0 3	0 445/0 59-0 3	0 055/0.06-0 05
3 1	0.077/0 16-0 05	0 02/0.02	0 8/1 1-0 6	0 23/0 45-0 10	0.05/0.05-0.05
Painesville WTTP					
2.8	0.08/0.15-0 05	0.02/0.02-0 02	0 8/1 0-0 7	0.37/0 52-0 13	0.05/0 05-0.05
2 3S	0 07/0 12-0 05	0.02/0 03-0 02	0 9/1 1-0 7	0.56/1 21-0 25	0 05/0 06-0 05
2 3B	0 06/0 11-0 05	0 02/0.02-0 02	0 75/0 9-0 6	0 39/0 55-0 27	0 05/0 07-0 05
1 8S	0 06/0 11-0 05	0.02/0 02-0 02	0 85/1 0-0 7	0 32/0 47-0.18	0 07/0 13-0 05
1 8B	0 07/0 12-0 05	0 02/0 02-0 02	0 8/0 9-0 7	0 31/0 43-0 17	0.05/0 05-0 05
1 1S	0 06/0 09-0 05	0 02/0 02-0 02	0 7/0 9-0 4	0 19/0 34-0 13	0 05/0 05-0 05
1 1B	0 08/0 10-0 06	0 02/0 02-0 02	0 8/0 9-0 6	0.25/0 38-0 14	0 06/0 09-0 05
0 3S	0 06/0.10-0.05	0.02/0 02-0 02	0 4/0 8-0 3	0 17/0 31-0 10	0 07/0.1-0 05
0 3B	0.09/0.17-0.05	0 02/0 02-0 02	0 5/1 2-0 2	0 17/0.27-0 11	0.09/0 22-0 05
Big Creek					
16.6	1 13/1 6-0 72	0 03/0 04-0 02	1 9/2 3-1 8	0 09/0 11-0 06	0 41/0 49-0 29
14 0	0 69/1.67-0 12	0 247/0 34-0.13	1 6/2 5-0 8	3 03/3 76-1 59	1 94/2 7-0 84

(cont.)

Table 4 (continued)

METALS

STREAM RM	Hardness (mg/l)	Ca-TOT (mg/l)	Mg-TOT (mg/l)	Fe-TOT (ug/l)	Cd-TOT (ug/l)	Cr-TOT (ug/l)
22.5	93/112-65	26/31.6-18	6.7/8-5	1152/2080-390	-	-
8.5	104/124-69	29/35-19	7.57/9-5.3	1310/2420-380	-	-
6.1	118.6/128-103	33.5/36.2-29.3	8.5/9.2-7.3	930/1610-370	-	-
5.5	109.3/129-77	30.7/36.7-21.3	7.9/9.3-5.9	1535/3310-350	-	-
3.1	522/865-223	193/329-77	9.5/10.6-7.7	663/1030-220	<0.2/<0.2-0.2	<30/<30-30
Painesville WWTP						
2.9	464/920-216	171/351-74	8.9/10.5-7.3	915/1650-400	<0.2/<0.2-0.2	<30/<30-30
2.3S	448/783-224	164/296-77	9.1/10.7-7.6	957/1820-440	<0.2/<0.2-0.2	<30/<30-30
2.3B	441/754-222	161/284-76	9.1/10.8-7.6	1107/1890-610	<0.2/<0.2-<0.2	<30/<30-<30
1.9S	323/472-208	115/172-70	8.8/10.4-7.4	850/1270-380	<0.2/<0.2-0.2	<30/<30-<30
1.9B	343/477-207	122/174-69	9.0/10.5-7.4	1312/1710-1120	<0.2/<0.2-0.2	<30/<30-<30
1.1S	220/323-129	74/113-39	8.5/9.8-7.6	805/1250-430	<0.2/<0.2-<0.2	<30/<30-<30
1.1B	228/267-194	76/90-64	8.7/10.1-7.5	2202/3710-1190	<0.2/<0.2-<0.2	<30/<30-<30
0.3S	137/165-123	41/52-35	8.2/8.7-8.0	505/1120-240	<0.2/<0.2-<0.2	<30/<30-<30
0.3B	159/186-121	50/61-35	8.2/9.2-7.6	1490/2370-650	<0.2/<0.2-<0.2	<30/<30-<30
Big Creek						
16.6	179/196-167	56.1/60.6-52	10.1/10.8-9.1	1712/2110-810	-	<30/<30
Chardon WWTP						
14.0	198/220-136	59.4/65.4-42.9	12.1/14.1-6.9	675/1560-280	-	<30/<30

(cont.)

Table 4 (continued)

METALS (continued)

STREAM RM	As-TOT (ug/l)	Cu-TOT (ug/l)	Pb-TOT (ug/l)	Ni-TOT (ug/l)	Zn-TOT (ug/l)
22.5	-	-	-	-	15/20-10
8.5	-	-	-	-	28/45-15
6.1	-	-	-	-	25/25
5.5	-	-	-	-	21.3/45-10
3.1	2.5/3-2	7.3/10-4	2/2-2	<40/<40-<40	<10/<10-<10
Painesville WWTP					
2.8	<2/<2-2	4.2/10-2	3/7-2	<40/<40-<40	<10/<10-<10
2.3S	2.3/3-2	5.5/10-3	4.5/8-3	<40/<40-<40	<10/<10-<10
2.3B	2/2-2	5.5/10-4	3/7-2	<40/<40-<40	17/25-10
1.8S	2/2-2	<0.2/<0.2-0.2	3.5/6-2	<40/<40-<40	10/10-10
1.8B	2.3/3-2	0.2/<0.2-<0.2	3.7/6-2	<40/<40-<40	32/100-10
1.1S	2/2-2	<0.2/<0.2-<0.2	2.5/4-2	<40/<40-<40	<10/<10-<10
1.1B	2.3/3-2	<0.2/<0.2-<0.2	3.8/5-2	<40/<40-<40	12.5/20-10
0.3S	2/2-2	<0.2/<0.2-<0.2	2.5/4-2	<40/<40-<40	<10/<10-<10
0.3B	2.3/3-2	<0.2/<0.2-<0.2	3.2/4-2	<40/<40-<40	10/10-10
Big Creek					
16.6	-	-	-	40/40	10/10
14.0	-	-	-	40/40	10/10

(cont.)

Table 4 (continued)

MISCELLANEOUS

STREAM	Na-TOT (mg/l)	K-TOT (mg/l)	Chloride (mg/l)	Fecal Coliform */100 ml
22 5	14/18-10	-	20/26-14	144/340-40
8 5	16/19-12	-	23/28-15	192/330-80
6.1	19.3/21-17	-	27 3/30-24	270/420-120
5.3	17/21-10	-	25/31-15	215/460-100
3.1	145/235-60	4.3/6 1-3 9	420/889-165	265/470-57
2 8	145/308-61	5.1/6.7-4 0	447/961-171	300/490-110
2.3S	140/264-63	5.0/6.4-4 0	424/819-179	387/740-34
2.3B	138/252-63	5 0/6.3-4 0	429/786-179	-
1.3S	94/145-56	4 4/4.7-4 0	281/456-149	226/410-43
1.3B	100/145-53	4 6/5.2-4 1	313/478-145	-
1 1S	58/99-21	3 3/4 1-2 1	160/239-45	128/180-77
1.1B	61/81-46	3 7/4.1-3 1	159/174-124	-
0 3S	22/43-12	2 0/3.3-1 6	47/99-22	105/200-10

a (mean/maximum-minimum) with N=4 Means calculated using detection limit as the minimum value where reported minimum was less than detection limit.

Study Area

Population and industry are concentrated along the lower nine miles of the Grand River in the city of Painesville and the village of Fairport Harbor. Potential sources for water quality impacts include the village of Harpersfield, effluent and runoff from the Gibbs Industrial Park, the stormsewers servicing Glyco Chemical, Uniroyal, Arco Plastics, leachate and runoff from the Diamond Shamrock soda ash and chromate disposal landfills, the Painesville WWTP, Fairport Harbor WWTP, the Painesville Municipal Electric Plant (coal storage area), Republic Steel Grand River Lime Plant, the Fairport Harbor Water Treatment Plant, the Morton Salt bulk handling facilities at the mouth and the Chardon WWTP on Big Creek.

Previous biological and chemical/physical studies have documented good to excellent water quality upstream from the Lake Erie influenced area of the Grand River. Forty-two species of fish were collected in the segment between RM 9.3 and RM 5.3 during a survey conducted by NOACA in 1976 (NOACA 1978). This species list compared favorably with the potential species list for the segment and ranked it as one the highest quality segments evaluated by NOACA in northeast Ohio Chemical water quality revealed few problems. Iron has been the only parameter which regularly violated water quality standards in this segment although historically infrequent violations of phenols and lead have been reported.

Water quality problems in the Lake Erie influenced area of the Grand River have improved since the passage of the Clean Water Act of 1972. During the 1970's violations of water quality standards and/or elevated concentrations for iron, phenol, total dissolved solids, chrome and chlorides were regularly detected. Implementation of pollution control strategies and plant closings have resulted in reductions in water quality standard violations and reduced concentrations of the previously mentioned chemicals. Currently iron is the only parameter regularly violating WQS. Refer to Ohio EPA (1987a) for a more complete discussion of the study area and water quality trends in the Grand River

Big Creek

- The unsewered area upstream from the Chardon WWTP showed evidence of impacted water quality with depressed dissolved oxygen concentrations at every collection. Elevated total phosphorus from the Chardon WWTP further impacted the water quality of Big Creek.

Physical Habitat for Aquatic Life(Figure 4, Table 8 and Appendix Table B)

Grand River

- A wide variety of habitats were encountered in the Grand River study area. Upstream from RM 4.8 the Grand River is a free flowing stream with typical stream riffle, pool, run sequences. Several sampling sites in this segment possess well developed riffles, a well defined main chute and numerous large boulders. However one site, RM 5.2, was dominated by a bedrock bottom and extensive shallows.

- The segment downstream from RM 4.8 is influenced by Lake Erie water levels. The stream is no longer free flowing with the direction and speed of current dependent on lake level conditions in Lake Erie . No riffles are present in this estuary area although vegetated backwaters provide another type of habitat.

- The Qualitative Habitat Evaluation Index (QHEI) in the upstream free flowing portions of the Grand River ranged from 64 at RM's 4.4 and 5.2 to 91 at RM 13.4 indicating that this segment possesses habitat capable of supporting good to exceptional warmwater biological communities. Habitat in the Lake Erie estuary area was less diverse with QHEI scores ranging between 50 at RM 0.6 and 64 at RM 4.4. These scores indicate that this area is capable of supporting warmwater biological communities typical of Lake Erie river mouth areas.

Big Creek

- Past channel activities in Big Creek upstream from Chardon result in poor habitat for supporting aquatic communities (QHEI=40). Downstream from Chardon QHEI's ranged from 50 at RM 15.9 to 83 at RM 9.5 indicating the presence of habitat capable of supporting fair to exceptional warmwater biological communities

Macroinvertebrates (Tables 5-6, Figure 3. Appendix Table A)

Grand River

- Upstream sites (RM 28.4, 22.6, 13.6 and 6.2) in the free flowing segment of the Grand River yielded exceptional macroinvertebrate communities with ICI's ranging from 46 at RM 22.6 to 52 at RM 13.6.

- Sampling sites at RM 8.6 and 5.4 (which were sampled only with qualitative methods) yielded good to exceptional macroinvertebrate communities. Qualitative taxa and EPT taxa declined compared to upstream values.

- Macroinvertebrate communities at the first site in the estuary area responding to the loss of riffle-run development yielded a somewhat lower ICI score (36) than found at upstream sites but still received an evaluation of very good.

- Stations in the Grand River estuary out of the influence of the free-flowing portions of the stream (RM 3.0, 2.1 and 0.8) yielded macroinvertebrate communities judged in the good range. This evaluation is based on comparision with sampling results from relatively unimpacted sites in other Lake Erie estuaries. ICI values ranged from 20 at RM 0.8 to 24 at RM 3.0.

Big Creek

- The macroinvertebrate community in Big Creek upstream from Chardon was impacted by the unsewered area and the previous channelization. The community was judged as poor at this site, RM 16.1, with only 28 taxa collected.

Table 5. Macroinvertebrate community metrics and criteria for calculating the Invertebrate Community Index (ICI) and ICI scores for evaluating biological condition (Ohio EPA, 1987).

	Metric	Score 0	2	4	6
1	Total Number of Taxa	Varies with drainage area (Fig. 5-1)			
2.	Total Number of Mayfly Taxa	Varies with drainage area (Fig. 5-2)			
3	Total Number of Caddisfly Taxa	Varies with drainage area (Fig. 5-3)			
4.	Total Number of Dipteran Taxa	Varies with drainage area (Fig. 5-4)			
5	Percent Mayfly Composition	0	0-17	17-34	>34
6	Percent Caddisfly Composition	Varies with drainage area (Fig. 5-6)			
7	Percent Tribe Tanytarsini Midge Composition	0	0-18	18-36	>36
8	Percent Other Dipteran and Non-Insect Composition	Varies with drainage area (Fig 5-8)			
9	Percent Tolerant Organisms (from Table 5-2)	Varies with drainage area (Fig. 5-9)			
10	Total Number of Qualitative EPT Taxa	Varies with drainage area (Fig. 5-10)			

Table 6 . Summary of macroinvertebrate data collected from artificial substrate samplers and from natural substrates in the Grand River and Big Creek study area, July 29 to September 10, 1987.

Station River Mile	Evaluation	Invertebrate Community Index	No Quant. Taxa	No. Qual. Taxa	Density (/ft.2)
Grand River					
28.4	Exceptional	50	35	68	2180
22.6	Exceptional	46	43	63	489
13.6	Exceptional	52	44	66	1247
6.2	Exceptional	48	44	64	1117
4.3	Good	36[a]	42	46	441
3.0	Fair	24[a]	33	30	1104
2.1	Fair	22[a]	23	28	1315
0.8	Fair	20[a]	23	31	737

Station River Mile	Evaluation	No. Qual. Taxa	Relative Density	Predominant Organisms
Grand River				
8.6	Good-exceptional	48	Moderate	Caddisflies,midges,stoneflies
5.4	Good-exceptional	58	Moderate	Caddisflies, midges

a- Biological criteria for ICI in Ohio EPA (1987b) do not apply in Lake Erie river mouth areas. Evaluation is based on best professional judgement.

Table 6 (cont'd)

Station River Mile	Evaluation	No. Qual. Taxa	Relative Density	Predominant Organisms
Big Creek				
16.1	Poor	28	Low	Midges
15.8	Poor	20	Moderate	Midges
14.2	Fair	38	Moderate	Hydropsychid caddisflies, blackflies

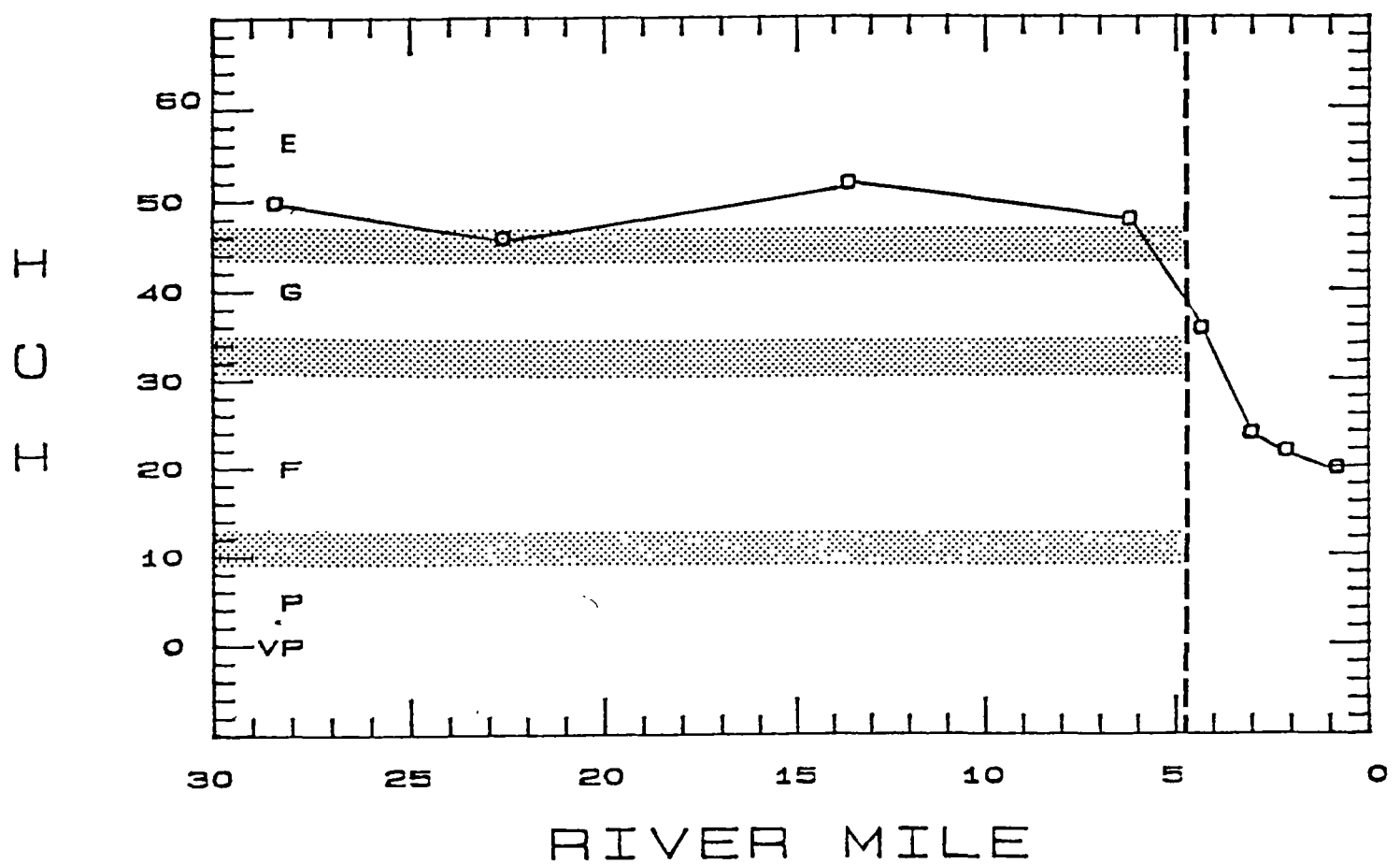

Figure 3 Longitudinal trend of the Invertebrate Community Index (ICI) in the Grand River and Big Creek study area, 1987. E denotes exceptional invertebrate communities (meets EWH criteria), G denotes good invertebrate communities (meets WWH criteria), and F, P, and VP denote fair, poor, and very poor invertebrate communities (non-attainment of aquatic life use)

- Downstream from the Chardon WWTP organic enrichment resulted in a macroinvertebrate community also judged poor although organism density increased moderately.

- Some improvement was noticed at the next site downstream with the community improving to the fair range. Number of taxa collected increased from 20 to 38.

Fish (Tables 7-8, Figure 4, Appendix D-E)

Grand River

- The fish community in the free flowing segment of the Grand River generally attained or partially attained exceptional warmwater habitat criteria where habitat was not evaluated as being a limiting factor.

- Habitat in the form of bedrock shallows prevented exceptional warmwater habitat attainment at RM 5.2. Discharges from the Gibbs Industrial Park resulted in no discernable instream impact to the fish communities.

- Sampling sites in the Lake Erie estuary area fully attained WWH criteria with the exception of the two sites immediately downstream from and adjacent to the two landfills (RM 4.4 and 3.0) were clearly impacted by leachate from these facilities. Habitat did not appear to be a major factor contributing to the non-attainment at these sites, since QHEI scores were roughly comparable to the other sites in the estuary.

- The occurrence of the intolerant river redhorse and black redhorse downstream from the Painesville WWTP (RM 2.0) coupled with IBI and IWB scores of 40 and 8.6 respectively support the observation that the WWTP did not adversely impact the fish community.

- The IBI and Iwb scores recorded at RM 2.0 and 0.6 rank among the highest that the Ohio EPA has measured at Lake Erie river mouth sampling sites. The site at RM 0.6 appears to have the potential for even better community performance. However silt, sand and gravel deposits resulting from runoff from the adjacent material handling facility limit the fish

Table 7. Fish sampling methods used in the Grand River and Big Creek study area by the Ohio EPA during May- September, 1987.

Stream Name	River Mile	Sampler Type	Number of Samples	Distance Sampled
Grand River	22.6	A	2	0.50
Grand River	22.1	D,A	2	0.20
Grand River	22.0	A	2	0.44
Grand River	13.4	A	2	0.50
Grand River	13.3	A	A	0.50
Grand River	9.0	A	2	0.50
Grand River	8.9	A	2	0.45
Grand River	6.1	A	2	0.50
Grand River	5.2	A	3	0.50
Grand River	4.4	A	3	0.50
Grand River	4.3	A	2	0.50
Grand River	3.0	A	3	0.50
Grand River	2.9	A	2	0.50
Grand River	2.0	A	3	0.50
Grand River	1.9	B	2	0.50
Grand River	0.6	A	3	0.50
Big Creek	16.3	E	3	0.12
Big Creek	15.9	D	3	0.17
Big Creek	13.9	D	3	0.20
Big Creek	9.5	D	3	0.20

a Methods used in this survey follow guidelines established in Ohio EPA (1987b) unless otherwise indicated.

Table 8. Fish community indices based on electrofishing samples at 16 locations sampled by Ohio EPA in the Grand River and Big Creek study area during July-September, 1987.

Stream River Mile	Mean No. of Species	Cumulative Species	Mean Relative Number	Mean Relative Weight	Composite Index	Modified Composite Index	Index of Biotic Integrity	QHEIa	Narrative Evaluation
Grand River									
22.1	22.0	21	421.5	7.3	9.3	9.3	50	82	nsd EWH
13.4	23.5	22	562.0	32.9	9.5	9.5	48	91	nsd EWH
9.0	23.5	23	137.4	15.2	8.8	8.7	47	80	Part.EWH
6.1	24.5	20	326.0	64.6	9.4	9.4	54	77	= EWH
5.2	20.0	14	96.0	3.9	8.4	8.4	45	64	WWH
4.4[b]	16.0	13	142.0	123.5	7.7	6.7*	29[ns]	64	Non-attain.
3.0[b]	11.7	17	118.0	15.3	6.1	5.9*	30[ns]	52	Non-attain.
2.0[b]	17.0	18	184.0	25.5	8.4	8.3	40	60	WWH
0.6[b]	19.0	17	370.0	58.5	8.9	8.3	33	50	WWH
Big Creek									
16.3[c]	8.0	9	602.5	0.0	4.3	4.0	40	40	WWH
15.9[c]	5.3	8	227.7	0.0	4.1	2.3	23*	50	Non-attain
13.9[c]	9.0	11	580.5	5.1	5.6	4.8	28*	67	Non-attain.
9.5[c]	14.7	14	1963.5	20.4	8.5	8.0	42	83	Part. WWH

Ecoregion Scoring Criteria

	Exceptional Warmwater Habitat		*Warmwater Habitat*	
	IBI	IWB	IBI	IWB
Boat	50	9.5	36	8.3
Wading	50	9.4	38	8.0
Headwaters	50	N/A	40	N/A
Estuary areas	N/A	N/A	32	>7.5

a QHEI Qualitative habitat evaluation index

b estuary area sites

c headwaters sites (Iwb criteria do not apply)

* significant departure from biological criteria.

ns non-significant departure from biological criteria (4IBI units; 0.5 Iwb units)

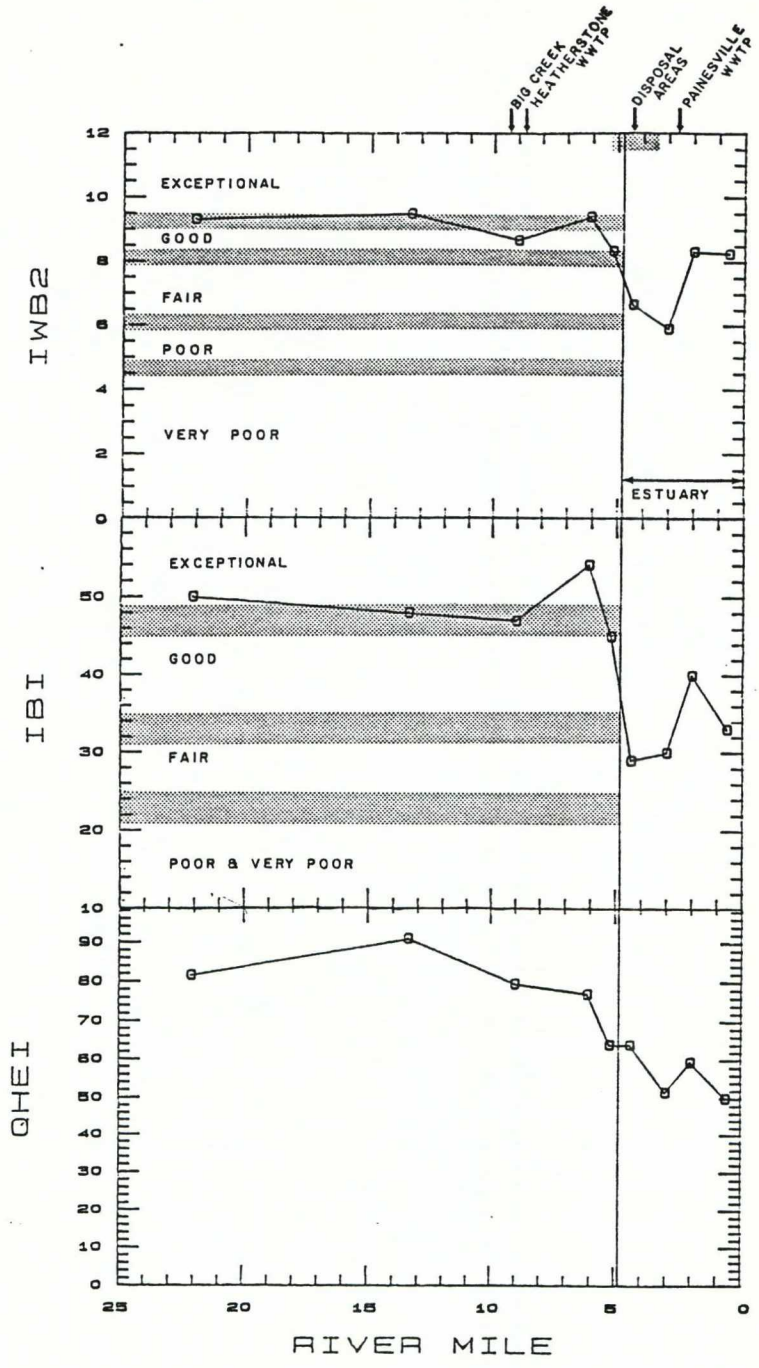

Figure 4. Longitudinal trend of the Modified Index of Well-Being (+ SE), Index of Biotic Integrity (+ SE), and the Qualitative Habitat Evaluation Index (QHEI) at 16 locations in the Grand River study area based on electrofishing collections during July-September, 1987

community to existing levels. Only juvenile fish were found in this area with the adult fish concentrated in beds of water celery at the end of the zone.

Big Creek

- The fish community at RM 16.3 achieved WWH criteria despite obvious indications of nutrient enrichment in the unsewered area of Chardon (i.e. the presence of sewage fungus) and poor habitat.

- Organic enrichment from the Chardon WWTP resulted in significant non-attainment of WWH criteria (values in the fair to poor range) at the two sites immediately downstream from the WWTP .

- Recovery from the impact of the Chardon WWTP to Warmwater Habitat levels was achieved at RM 9 5, 6.5 miles downstream from the WWTP

Summary- (Table 6,8 &9)

Grand River

The existing aquatic life use designation of the Grand River and Big Creek is Warmwater Habitat. The Grand River is also classified as a State Resource Water (SRW) from Route 322 to the Norfolk and Western railroad trestle south of Painesville and as Seasonal Salmonid Habitat from the Harpersfield Dam to the mouth. The results of the 1987 biological survey indicate that the use designation of the Grand River should be changed to Exceptional Warmwater Habitat (EWH) from its headwaters to one half mile downstream from the Route 2 bridge where the extensive bedrock bottom precludes full attainment of the EWH use. The Lake Erie estuary area should retain its Warmwater Habitat (WWH) use designation pending further research into the biological potential of Lake Erie estuaries. Big Creek should also retain its WWH use designation.

Macroinvertebrate and fish communities show full attainment of the EWH use at all sites in the free flowing segment of the Grand River excluding the bedrock area just downstream from the Route 2 bridge and RM 9 0. The presence of a combined sewer overflow in the sampling zone at RM 9.0 was

Table 9. Summary of biological use attainment status for all sampling locations in the Grand River and Big Creek study area, 1987. Attainment status follows guidance in Ohio EPA (1987b).

River Mile	IBI	Mod. Iwb	Macroinvert. Evaluation	Attainment Status	Comments
Grand River					
28.4	-	-	Exceptional	Full	EWH
22.6	-	-	Exceptional	Full	EWH Nonsig. departure
22.1	50	9.3	-	Full	EWH Nonsig. departure
13.6	-	-	Exceptional	Full	EWH Nonsig. departure
13.4	48	9.5	-	Full	EWH Nonsig. departure
9.0	47	8.7	-	Part.	EWH CSO impacts IBI meets, IWB doesn't
6.2	-	-	Excectional	Full	EWH Nonsig. departure
6.1	54	9.4	-	Full	EWH
5.2	45	8.4	-	Full	WWH
4.4[a]	29[ns]	6.7*	-	Nonattain	WWH WQ impacts from landfill
4.3[a]	-	-	Good	Full	WWH Macros more tolerant
3.0[a]	30[ns]	5.9*	Fair	Nonattain	WWH WQ impacts from landfill
2.1[a]	-	-	Fair	Nonattain.	WWH WQ impacts from landfill
2.0[a]	40	8.3	-	Full	WWH
0.8[a]	-	-	Fair	Nonattain.	WWH Macros more sensitive
0.6[a]	33	8.3	-	Full	WWH Improved WQ with dilution by Lake Erie water

Table 9. (con't.)

River Mile	IBI	Mod. Iwb	Macroinvert. Evaluation	Attainment Status	Comments
Big Creek					
16.3	40	NA	-	Nonattain.	WWH Nutrient enrich., poor habitat
16.1	-	-	Poor	Nonattain.	WWH Nutrient enrich., poor habitat
15.9	23*	NA	-	Nonattain	WWH Nutrient enrich., poor habitat
15.8	-	-	Poor*	Nonattain	WWH Nutrient enrich , poor habitat
14.2	-	-	Fair	Nonattain	WWH Nutrient enrich., poor habitat
13.9	28*	NA	-	Nonattain	WWH Nutrient enrich.
9.5	42	NA	-	Attain	WWH

a Estuary site

* significant departure from biological criteria.

ns non-significant departure from biological criteria (-4 IBI units, 0.5 Iwb units)

responsible for the partial attainment of the EWH use. Other portions of the study area (i.e. the Grand River estuary and Big Creek) showed full attainment of the WWH use outside of areas impacted by degraded water quality.

Impairment and partial impairment of the WWH use was evident in the area adjacent to and downstream from the the Diamond Shamrock waste lagoons. Fish communities at RM 4.4 adjacent to the Diamond Shamrock salt lagoons clearly did not meet WWH criteria. One sampling on August 18th during a period of low flow yielded only five individuals of three species of fish with prior and subsequent sampling yielding 20 and 15 species respectively. Fish appear to have avoided this area during a period of high stress. Macroinvertebrate sampling at RM 4.3 however revealed ICI scores in the good range suggesting differing tolerances of the two organism groups to chemicals leaching from the lagoon. Indications of additional water quality impacts were found at the next site downstream, RM 3.0, which is downstream from both the Diamond Shamrock salt disposal lagoon and chromate disposal lagoon. Although the macroinvertebrate community marginally attained WWH criteria, the fish community was impacted with index scores in the fair range. Increased concentrations of total dissolved solids, calcium, sodium, and chlorides downstream from the lagoons also confirms problems with leaching from the lagoons and degraded water quality. The fish community showed improvement at the next site downstream, RM 2.0. Dilution of Grand River water by water from Lake Erie results in improved water quality and an improved fish community. This is important to note since this site is also downstream from the Painesville WWTP. No impact could be attributed to the Painesville WWTP.

Big Creek

Big Creek upstream from the Chardon WWTP supports a warmwater fish community despite obvious indications of nutrient enrichment (i.e. the presence of sewage fungus) and past channel activities. The macroinvertebrate community however was degraded by these impacts resulting in partial attainment of the warmwater use for this segment. Downstream from the Chardon WWTP nutrient enrichment adversely impacts both macroinvertebrate and fish communities. The macroinvertebrates partially recover from this impact at the downstream site, RM 14.2, with the number of qualitative taxa increasing from 20 to 38. The fish community did not achieve WWH criteria until the site at RM 9.5 approximately 6.5

miles downstream.

Recommendations

Based on the results of the 1987 intensive survey the following recommendations are made for the Grand River study area:

1. The aquatic life use designation for the Grand River should be changed from the current designation of WWH to EWH based on instream biological performance for the segment extending from the headwaters to RM 5.0.

2. The remaining Grand River from RM 5.0 downstream to the mouth should retain the WWH use pending further study into the biological potential of Lake Erie estuaries.

3. Big Creek should retain its WWH use designation.

4. Further investigation into the problem of leaching from the Diamond Shamrock salt and chromate disposal lagoons should be conducted. There is a need to identify where leachate or contaminated runoff is entering the stream, which chemicals are entering the stream, if there is acute or chronic toxicity associated with these discharges, the extent of the problem and methods to remediate the problem.

5. The unsewered area upstream from Chardon should be incorporated into a comprehensive wastewater treatment plan for Big Creek. There is a need for both increased capacity and improved treatment to yield effluent capable of supporting WWH biological communities.

6. The exceptional macroinvertebrate and fish communities present in the Grand River mainstem warrant protection through strict enforcement of the anti-degradation policy.

References

Northeast Ohio Regional Coordinating Agency (NOACA). 1978. Analysis of stream habitat. Tech. Appendix A21.

Ohio Department of Natural Resources. 1960. Gazetteer of Ohio streams. Ohio DNR, Div. of Water, Columbus, Ohio Ohio Water Plan Inventory Rept. No. 12. 179 p.

Ohio Environmental Protection Agency. 1987a. Lower Grand River and Fairport Harbor Assessment Report Supplement to the State of Ohio 305(b) Water Quality Inventory Division of Water Quality Monitoring and Assessment. Columbus, Ohio 62 pp (mimeo)

Ohio Environmental Protection Agency 1987b Ohio EPA manual of surveillance methods and quality assurance practices, updated edition Division of Water Quality Monitoring and Assessment, Evaluation and Standards Section, Columbus, Ohio.

Trautman, M.B. 1981. The fishes of Ohio (2nd edition) Ohio State Univ Press, Columbus. 782 p

LIST OF APPENDIX TABLES

inter-office communication

to. File date: March 16, 1988
from. Steve Tuckerman, CAS, DSHWM, NEDO

subject: Diamond Shamrock Chromium Site

Sue MacMillan (OEPA-NEDO-DSHWM-CAS) and I observed preparations for the required quarterly ground water sampling at the Diamond Shamrock Chromium Site per the July 14, 1983 Administrative Consent Order. When we arrived at the site at approximately 10:00 AM, Barry Leone and an assistant had just completed the bailing of well #8. We introduced ourselves and explained that we were there to observe their procedures. The next well to be bailed was #10. However, well #10 apparently was covered by materials used to stabilize the river bank and could not be found. The next well bailed was well #3. A water level measurement in the well was made with an electronic tape and the well was then bailed with a 2 inch plastic bailer. Deionized water was used for decontamination of the bailer and the electronic tape. The bailed water was placed into a five gallon plastic pail. When asked how much was bailed from the wells, Mr. Leone stated 10-15 bailer volumes or until dry. Mr. Leone stated that the bailed water was transported to their laboratory for disposal.

Wells #1 and 1A were bailed prior to our arrival. However, there was obvious evidence (ie. muddied soil and "green" snow) that the water bailed from the wells had been disposed on the ground. Paul Dugas from Maxus arrived at the site just as we were leaving. I informed Mr. Dugas of the likelyhood that bailed waters were disposed on the ground.

NOTE: Due to last minute changes by the Diamond Shamrock sampling crew, this site visit observed well bailing procedures only and not well sampling techniques as planned.

cc: Dan Bicknell